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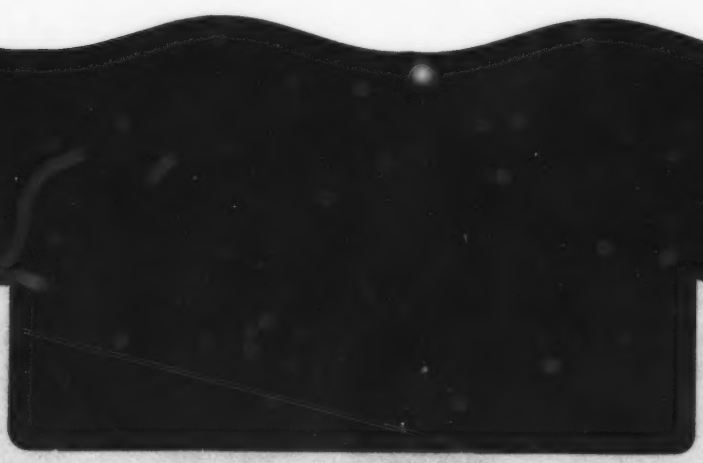
Marine Casualty Investigations

Enquêtes sur les accidents maritimes



Investigation Report to the Minister pursuant to sections 477 or 480 of the Canada Shipping Act (1985)

Rapport d'investigation au Ministre conformément aux articles 477 ou 480 de la Loi sur la marine marchande du Canada (1985)

Canada

Ce rapport est aussi disponible en français

REPORT OF INVESTIGATION INTO THE CIRCUMSTANCES ATTENDING THE STRIKING OF A BERGY BIT OF ICE BY THE M.V. "TRAVE ORE", IN THE ATLANTIC OCEAN, NORTH-EAST OF NEWFOUNDLAND, JULY 6, 1989

REPORT No. 536

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REPORT OF INVESTIGATION INTO THE CIRCUMSTANCES ATTENDING THE STRIKING OF A BERGY BIT OF ICE BY THE M.V. "TRAVE ORE", IN THE ATLANTIC OCEAN, NORTH-EAST OF NEWFOUNDLAND, JULY 6, 1989

Particulars of Vessel

Name	"TRAVE ORE" ex "BELINDA" - 85
Official Number	10976
Port of Registry	Kaohsiung
Flag	Republic of China (Taiwan)
Gross Tonnage	57,871
Net Tonnage	34,805
Deadweight (summer draught)	108,200 tonnes
Length	260.604 m
Breadth	40.735 m
Depth	20.174 m
Draught (on departure Port Cartier July 3, 1989)	13.87 m F 14.39 m A
Type	Bulk/ore carrier, nine cargo holds
Hull	Steel, welded
Built	Harland and Wolff Ltd. Belfast, N. Ireland
Propulsion	B&W, 9 cylinder, 23,200 BHP, driving a single, non-variable pitch propeller
Cargo	98,838 t iron ore concentrate
Crew	26 including master
Owner	Sincere Navigation Corporation Taipei, Taiwan

Managers	Oak Steamship Company Ltd. Hong Kong
Local Agents	Kerr Steamships (Canada) Ltd. Halifax, Nova Scotia
Classification	Jointly: Republic of China Ship Registry Det Norske Veritas Classification A/S

Navigational Equipment

Radar (1)	Raytheon 10 cm	1660/125 1020/6x Pathfinder ARPA Range 64 miles	Master No. 1 Slave No. 2 Slave
Radar (2)	Raytheon 3 cm	1225/6x, Range 64 miles	
Echo Sounder (1)		Simrad - Chart Room	
Echo Sounder (2)		Simrad 1C - Wheel-house	
Decca Navigator (1)		MK21	
Satellite Navigator (1)		SN - 83 MK II	
Gyro Compass		Anschutz 31718 plus 3 repeaters	
Magnetic Compass		Sestral 9180	
Radio Direction Finder		Plath SFP 705 LNG	

Radio Equipment

VHF (1)	STR 65
VHF (2)	ITT Marine STR 12
Weather and Ice Information Receiver (1)	FAX 108

Radio room fitted with equipment for world wide marine frequencies.

Main W/T Transmitter	EB 1500
Main W/T Receiver	EB 3020A

MF Radiotelephone	EB - Electrisk Bureau
Emergency W/T Transmitter	EB 00108
Emergency W/T Receiver	EB 400

All radio equipment was serviced/calibrated in September, 1988 and was found to be in satisfactory condition.

Description of Vessel

The "TRAVE ORE", a bulk/ore carrier, was built in 1972. She has nine holds, is strengthened for heavy cargoes but is not fitted with cargo-handling equipment.

The vessel has a flush main deck and a raised forecastle. Between the main deck and the top of the forepeak tank is a void space approximately 4 m high. The engine room and accommodation are situated aft.

Certificates

All the vessel's certificates were valid at the time of the casualty.

NOTE: (1) All times mentioned in this report have been reduced to Atlantic Daylight Saving Time (UTC minus 3 hours).

(2) All references to The Canada Shipping Act in this report refer to Chapter S-9-1985 of the Revised Statutes of Canada.

Background

The "TRAVE ORE" departed Port Cartier, Quebec, on July 3, 1989, with a cargo of iron ore concentrate, bound for Hamburg, West Germany.

The intended route was from the Strait of Belle Isle, following a great circle course (the shortest distance) to the Pentland Firth, north of Scotland, thence via the North Sea to her destination.

Whilst steaming at nearly 12 knots, 158 miles east of Belle Isle, in dense fog, she struck a bergy bit of ice. The impact considerably damaged the bow and caused flooding in three compartments.

As this vessel is too large to be accommodated in any

dry-dock in eastern Canada, no permanent repairs were contemplated.

Temporary repairs at Corner Brook, Halifax and Quebec City necessitated discharging and reloading some 16,000 tons of cargo at Halifax, discharging all the cargo at Quebec City, and reloading part of it.

The temporary repairs carried out at Corner Brook and Halifax did not satisfy the requirements of the Canadian Authorities and for practical and economic reasons "TRAVE ORE" sailed to Quebec City on August 29 for further survey and more comprehensive temporary repairs, including a 400 tonne 'cement box'. The estimated cost of temporary repairs totalled approximately $4 million.

Narrative

M.V. "TRAVE ORE" loaded a cargo of approximately 98,838 t of iron ore concentrate at Port Cartier, Quebec, for delivery at Hamburg, West Germany. She sailed from Port Cartier at 2300, July 3, 1989, and after following various courses down the St. Lawrence River, off the Quebec north shore, reached the Atlantic via the Strait of Belle Isle.

On July 5, at 1630, she took her departure from a position 7 miles south of Belle Isle. From the time the "TRAVE ORE" commenced her voyage off Port Cartier to the time she struck the bergy bit, her average speed was approximately 11.98 knots with the propeller revolutions constant at 85 per minute, this being the ship's normal full sea service speed. Fog was first experienced approximately 96 miles before reaching Belle Isle and was reportedly dense thereafter.

After leaving the outbound traffic zone south of Belle Isle, "TRAVE ORE" picked up on her radar six icebergs on or near her course line, some of which necessitated an alteration of course. Their positions were reported via Canadian Coast Guard Radio Stations. No reduction of speed was deemed necessary during these manoeuvres.

At approximately 0540, July 6, in approximate position 52°27'N, 51°13'W; i.e., some 158 miles east by north of Belle Isle, in daylight conditions but still thick fog, the vessel struck a large piece of ice which was seen by the first mate and quartermaster only after it had been struck. Considerable damage was caused to the bow and forward section of the ship.

The forepeak tank, No. 1 port wing tank and No. 1 cargo hold flooded and the shell plating on both sides of the

bow was heavily set in.

The vessel was not stopped, however, and continued at full speed for a further 50 minutes and then for a further 1 hour 18 minutes at reduced speed before stopping the engine.

As a result of this damage, the ship's owners decided to direct the ship to Halifax, Nova Scotia, for survey and repairs. Whilst enroute to Halifax, adverse weather warnings prompted a diversion to Corner Brook, Newfoundland, arriving there at 0912, July 11.

At anchor, off Corner Brook, the vessel was attended by representatives of parties interested in the venture and Canadian Coast Guard staff.

An underwater survey, divers' report and video film revealed that the necessary repairs to the damage were more than could be undertaken at Corner Brook. The vessel was permitted to sail to Halifax with a tug escort and with portable pumps in No. 1 cargo hold.

The "TRAVE ORE" arrived off Halifax on July 16, entered the port the following day and commenced discharging cargo from No. 1 hold July 25. Concurrent with the cargo work, underwater repairs were carried out and by August 12 the ore from No. 1 hold had been discharged onto barges.

Underwater work had trimmed the shell plating in way of the bulbous bow and forepeak. The holes in No. 1 port wing tank were plated over and the water ingress into No. 1 cargo hold was stopped.

The collision bulkhead was reinforced and the forepeak tank was subdivided by plating in the after section. Approximately 14,000 t of cargo was reloaded into No. 1 hold. Approximately 2,000 t was loaded into No. 6 cargo hold to achieve a draught of forward 14.25 m, midships 14.25 m and aft 14.70 m. In that condition, the "TRAVE ORE" departed Halifax Harbour, at 1000, August 29, bound for Quebec City for further survey and repairs prior to continuing her voyage to Hamburg.

The vessel underwent further temporary repairs at Quebec City after having completely discharged her cargo. After reloading 88,390 t of her cargo on completion of repairs, the vessel departed Quebec City for Hamburg on October 13, 1989, at a draught of 12.24 m forward and 14.51 m aft.

It was recommended to the master by the Canadian Coast

Guard and other interested parties that the vessel proceed via the Cabot Strait to 46°N, 53°W, and thence by a rhumbline course to the English Channel at a speed not to exceed 8 knots in a calm sea.

Analysis

1. Weather

The weather at the time of the casualty, as recorded in the deck log book, on the morning of July 6, 1989, in position 52°27'N, 51°13'W, was winds fresh southerly (17 to 21 knots), seas rough (about 2 m high) and a 'rough' swell. Visibility was zero in dense fog.

2. Ice - General

Icebergs, mainly from the glaciers of west Greenland, are carried southward by the cold Labrador current to the waters of the Grand Banks. (See Chartlet.) It is in this area, where the Labrador current converges with the significantly warmer waters of the Gulf Stream, that sea water temperature differences of up to 20°C can exist. The formation of dense fog occurs up to 40 to 50% of the time. The combined threat of fog, icebergs and severe North Atlantic storms makes the Grand Banks one of the most dangerous areas in the world for marine transportation.

The intended route of the "TRAVE ORE" was through this area.

3. Bergy Bits

The estimated height above the surface of the sea of the piece of ice, struck by the "TRAVE ORE", was approximately 3 m. On that basis, there would have been approximately 27 m beneath the surface. Such a 'height of ice' falls into the definition of a 'bergy bit' whose surface area could be approximately 2,100 sq m and would represent a mass of approximately 1,500 tonnes.

4. Ice/Weather Bulletins

(Annex I contains definitions of iceberg, bergy bit and growler and also describes the system of ice reporting and information distribution.)

Before reaching the Strait of Belle Isle, various messages had been received by the ship, mainly via the

main radio receiver, operated by the radio operator, who presented the ice patrol bulletins to the master. These bulletins repeatedly warned of the dangers of navigating in ice-infested waters and urged extreme caution. Weather reports, iceberg positions and sightings were also received as well as ice information on the weather/ice facsimile unit.

The ice information was known to master and mates alike and, although the Canadian booklet, Ice Navigation in Canadian waters, was not on board, other publications were available.

A message to "TRAVE ORE" from Ice Operations, St. John's, at 1750 UTC contained the following:

> Be advised that in the Eastern Approaches to the Strait of Belle Isle along the east bound shipping routes between 51°N and 54°N there are many to numerous icebergs.... Mariners are advised to navigate with extreme caution in ice/iceberg-infested waters...

An iceberg analysis chart received aboard showed that the vessel had cleared the area of concentrated icebergs and that she was approaching the predicted eastern limit of reported icebergs. It should be noted, however, that growlers and bergy bits, too small to be specifically identified by ice patrols, must also be expected in these areas and regular ice bulletins specified this fact.

5. Plotting Sheet

The positions of icebergs, and periodic positions of the ship by using the satellite navigator, were recorded throughout the night of July 5 and the morning of July 6 on a plotting sheet, corresponding in latitude and longitude with a large scale chart of the appropriate area of the North Atlantic. At about midnight, before retiring for the night, the master wrote a further instruction on the plotting sheet, in Mandarin, translated as:

> Keep record of iceberg position at night. Report to Coast Guard by telegram tomorrow.

6. Radars

The "TRAVE ORE" was fitted with two radar systems.

One radar set, identified as No. 3, a 3 cm band unit, was not operational at Corner Brook on July 12 and at Halifax on July 21 but had been recorded as being 'normal' and operational on July 6. Both radars were reportedly able to be used at the time of casualty but the ranges selected cannot be determined. A 3 cm band radar is generally considered superior to a 10 cm as it results in a clearer picture. However, the 3 cm set is affected more by rain, hail and snow and it will not only show more rain clutter but its effectiveness will be reduced by precipitation, and the ability to detect targets beyond the precipitation will also be reduced.

The other radar, a 10 cm band unit, comprised a master and two slaves, all of which received their signals from a common antenna. There can be some confusion in operating this system as the gain, sea clutter and rain clutter on all three displays interact with each other.

To pick up a small target, the gain must be turned up fully and the sea clutter fully off. When this is done, the sea clutter out to about 0.5 mile around the ship is so heavy that any target is hidden in the clutter.

As the sea clutter is adjusted to see any targets around the ship, the gain at the 3-4 mile range is reduced and any small target at this range may be lost.

It is probable that in the sea conditions prevailing at the time, the low target of the bergy bit would not be detectable by the radar. (See Annex II for an extract on the use of radar in ice.)

7. **Possible Cause of Striking**

On the morning of July 6 after 0445, only one radar was in use, the 10 cm 'S' band radar. It reportedly did not detect the presence of the bergy bit of ice ahead of the "TRAVE ORE". There was no dedicated look-out posted and no .sea water temperatures were taken or recorded by the navigating officers.

The first mate estimated the height of the piece of ice to be about 3 m above the surface of the sea; i.e., about 1 m higher than the crests of the waves.

Such a bergy bit would not present a good radar target

and may easily have been lost in the sea clutter.

8. **The Collision Regulations**

International Regulations for Preventing Collisions at Sea, 1972, (see Annex V) are recognized by all major maritime nations and state in part:

> Rule 2
>
> Responsibility
>
> (a) Nothing in these Rules shall exonerate any vessel, or the owner, master or crew thereof, from the consequences of any neglect to comply with these Rules ...
>
> Rule 5
>
> Look-out
>
> Every vessel shall at times maintain a proper look-out by ...

On the "TRAVE ORE" no dedicated look-out was posted. The quartermaster, whilst keeping a watch on the navigation bridge, checked the courses to be steered, the compasses and also acted as look-out.

> Rule 6
>
> Safe Speed - International states in part:
>
> Every vessel shall at all times proceed at a safe speed ...

The master and mates fully realized they were navigating in ice-infested waters, proceeded at the vessel's (then) full speed of approximately 12 knots and were aware that at that rate it would require considerable time and distance to stop the vessel.

A manoeuvering diagram was posted in the wheel-house, providing information regarding the vessel's turning circle and stopping distances.

9. **Standing Orders**

In the wheel-house was posted a copy of the master's 'Standing Orders', signed by the three mates, and which states in part in English:

The following standing orders are for your guidance when standing on the bridge at sea. You are expected to sign when read and thoroughly understood, and then carry out to the later (sic).

1. Before taking over the watch, read and sign the night orders ...

2. ... and keep a sharp look out.

3. Never hesitate to call captain when you are in doubt, altering course or stopping engine if necessary when involved in imminent risk at sea. SAFETY FIRST always put in your mind.

6. In thick or hazy weather, attend to all regulations, see that the automatic fog signal is in order and located so that it can be put in service immediately.

8. Energise the radar and any other electronic navigational aids if necessary, but don't give up the sight observation.

10. Night Order Book

Written in Mandarin and for the night of July 5, 1989, states:

1. True course 075°(T) keep and adjust the course as pre-determined.

2. Thick fog. Watch attentively. Keep radar in operation during the duty. Pay special attention to weak trace at short distance.

3. When iceberg is found at night keep sailing at a long distance from it in order to be safe.

4. Keep fog signal operating all the time and inform the main engine to be prepared for use.

5. Any questions or problems, please let me know.

This was written and signed by the master at approx-

imately 1900, July 5, who shortly afterwards left the bridge and returned about midnight. These night orders were acknowledged by the mates, by their signatures.

11. Previous ice casualties reported to Canadian Authorities

Fishing vessels, tankers, bulk cargo carriers and ferries have, in recent years and despite being equipped with radar and being provided with advance warning, suffered various damage and loss due to ice, mainly as a result of excessive speed and human error.

In eastern Canadian waters during the last 12 years, according to MCI statistics, 44 vessels of various types have either been damaged or sunk. Amongst these, a large bulk carrier inbound for the Gulf of St. Lawrence in June, 1982, equipped with two operational radars and on a dark night with good visibility, collided with an iceberg some 135 miles east of Newfoundland. The iceberg, reported to be 18 m high with a calculated mass of some 625,000 tons, had been previously identified and navigation warnings had been issued. There were no injuries. A large Canadian registered ferry sank on June 3, 1977 after encountering heavy pack ice off the coast of Labrador and there were no icebergs reported in the vicinity. All 112 persons aboard were safely rescued with no injuries.

12. Damages Sustained

After temporary repairs at Halifax, Nova Scotia, CCG Ship Safety required further survey and more comprehensive repairs, for which lightening and trimming the vessel were necessary.

The vessel's loaded draught was too great for berthing facilities at Halifax and for practical and economic reasons regarding cargo handling the vessel sailed to Quebec City.

There, the whole amount of cargo was discharged and additional repairs were carried out (including the pouring of some 400 tonnes of cement into the forepeak compartment).

It was estimated that the cost of temporary repairs, associated work and services at Corner Brook, Halifax and Quebec City are approximately $4 million. A comprehensive list of damages is not possible until

the vessel is dry docked and underwater areas surveyed; however, from above water areas, divers' reports and underwater video films, the attached sheet of possible permanent repairs forms Annex III. An estimate of the cost of permanent repairs is not known at this time.

From what is known, permanent repairs encompass replacing the shell plating from the stem back to the collision bulkhead and for some length beyond (approximately 15 m), including the bulbous bow.

This area, formed by the forepeak tank, the void space, the main deck and the fo'c'sle deck, had been severely damaged together with the internals in these compartments. (See photographs.) No. 1 port side double bottom tank (capacity 1,100 cu m) had also been holed in five areas, and was full of water.

Shell plating on the port side of No. 1 cargo hold, close to the collision bulkhead, had been fractured, allowing ingress of water.

13. **Pumping Capabilities**

As the forepeak and No. 1 port double bottom tanks were open to the sea, the inflow of water was greater than could be pumped out by the ship's pumps. Whilst No. 1 cargo hold was flooding at a slower rate, the bilge in that compartment became choked with iron ore, and was unpumpable by the ship. Enroute to Corner Brook, portable pumps were put on board the ship by a Canadian Coast Guard helicopter. These were not used as the suction line from the pumps was not long enough to reach the water in No. 1 cargo hold and the connections were incompatible with those on the ship.

At Corner Brook portable pumps from the tug "IRVING MAPLE" were utilised to lower the water level in No. 1 cargo hold. These pumps were retained on board the vessel to keep in check the ingress of water on the voyage to Halifax, and at Halifax, until the leaks in that compartment were otherwise stopped or controlled.

The vessel was cleared by Coast Guard Ship Safety to proceed from Corner Brook to Halifax subject to certain conditions being met for the vessel, crew and environmental safety, including that an adequate margin of stability be maintained should the cargo shift in No. 1 hold. The vessel was also to be escorted by a tug.

14. Cargo - Iron Ore Concentrate

Certain solid bulk cargoes present dangers when being transported by sea and efforts to obviate these risks prompted recommendations to be made.

These recommendations are contained in the International Maritime Organization (IMO), Code of Safe Practice for Solid Bulk Cargoes publication and the Canadian edition of the same name. The latter incorporates specific Canadian requirements as regards concentrates.

Transportation by sea of concentrates and ores from Canadian ports is supervised by Canadian Coast Guard. Prior to, and during loading of such a cargo, representative samples are tested to ensure the moisture content is within safety limits, as prescribed internationally and in the Canadian Code of Safe Practices for Solid Bulk Cargoes.

It is important to ensure that bulk cargoes are properly distributed throughout the ship; the "TRAVE ORE" was constructed for the carriage of such heavy cargoes and loaded to conform to predetermined criteria.

The ship had loaded approximately 98,838 t of ore concentrate at Port Cartier, Quebec, distributed in hold numbers 1,3,5, 7 and 9. The even numbered holds were empty. Of the total, approximately 16,799 t was stowed in No. 1 hold. (See Annex IV.)

The cargo was loaded in such a way that the stow was reasonably level, and pre-loading samples confirmed that the maximum moisture content was 4.5% i.e. within safe transportable limits.

The leveling is to help prevent a shift of cargo if the ship is rolling heavily.

The iron ore concentrate cargo on the "TRAVE ORE" was of a granular nature and as such, when saturated with water, loses its sheer strength and behaves like a liquid, or 'settles' to the bottom of the hold and surplus water creates a free surface above the cargo.

These conditions affect the stability of the ship.

The cargo discharged from No.1 hold, (which had been underwater after the casualty) was found to be self-

draining. The cargo was discharged onto an open dock area at Quebec City, where, during a two week period of dry weather, it was found to have less than 3% moisture content, prior to being safely reloaded.

15. **Fatigue Factor**

From the time of leaving Port Cartier, 2300, July 3, until south of Belle Isle at 1630, July 5, the passage had apparently been uneventful, the mates keeping 4 hour watches with 8 hours off duty between them, every 12 hours. The master was available at all times. Apparently the master and mates were well rested during that period, so that lack of concentration or stress is not considered a contributory factor to the casualty.

16. **Experience of Master and Officers**

Master

The master possesses a valid master's certificate issued at Taipei and is authorized to act as master on this class of ship. He also possesses certificates confirming competency in courses encompassing 'Radar Simulators' (ARPA) and 'Radar Observers'.

He served in the Republic of China's Navy for approximately 10 years, without command experience, and for approximately 12 years on merchant ships, of which about 1 year has been in command on other vessels. He joined this ship in June 1989 at Hamburg, West Germany, as master. Previous ice navigation experience is limited to the previous voyage from Hamburg to Port Cartier, Quebec, when icebergs were sighted off Newfoundland in clear weather with good visibility.

First Mate (On watch at time of accident)

The first mate possesses a valid certificate of competency as first mate, issued at Taipei, as well as certificates confirming competency in 'Radar Simulator' (ARPA) and 'Radar Observers' courses.

He has a total sea going experience of approximately 25 years of which some 10 years were spent in the Republic of China's Navy. Of the remaining 15 years, approximately 6 years has been in the capacity of first mate and he has been first mate on this ship for about 7 months. Apparently during the last few years

he had several voyages in ice-infested waters, mainly off the coast of Newfoundland.

Second Mate (On 12-4 watch prior to accident)

The second mate possesses a valid certificate of competency as first mate issued at Taipei as well as certificates attesting to competency in 'Radar Simulation' (ARPA) and 'Radar Observers' courses.

He has had approximately 12 years experience on this type of vessel and has been on this ship for about 5 months, during which time he navigated in foggy weather in ice-infested waters three or four times.

Quartermaster (Doubling as look-out) (On 4-8 watch at time of accident)

The quarter master, as an apprentice (or cadet), has had about 13 months total sea experience, all of which has been served on this ship. Experiences included familiarization with the different modes of steering, checking the compasses as well as keeping a look-out.

Findings

Whilst on passage from Port Cartier, Quebec, to Hamburg, Germany, some 150 miles north-east of Newfoundland in the Atlantic Ocean, in daylight but dense fog conditions, the "TRAVE ORE" struck a bergy bit of ice, stem-on, causing extensive damage, due to proceeding at full speed in restricted visibility in an area known to contain dangerous ice.

It would appear that the following factors contributed to the casualty:

- the vessel was proceeding at full service speed in dense fog;
- such a bergy bit of ice would be virtually impossible to detect by radar in the sea conditions prevailing at the time;
- no dedicated look-out was posted;
- the 10 cm radar in use had poor performance at short range, and
- ice warnings and the known fact that icebergs

were in the area did not induce extra vigilance.

Other Findings

Growlers and/or bergy bits, which are capable of causing serious damage to vessels and which may be too small to have been specifically identified by ice patrols, may be encountered within or close to ice-infested waters.

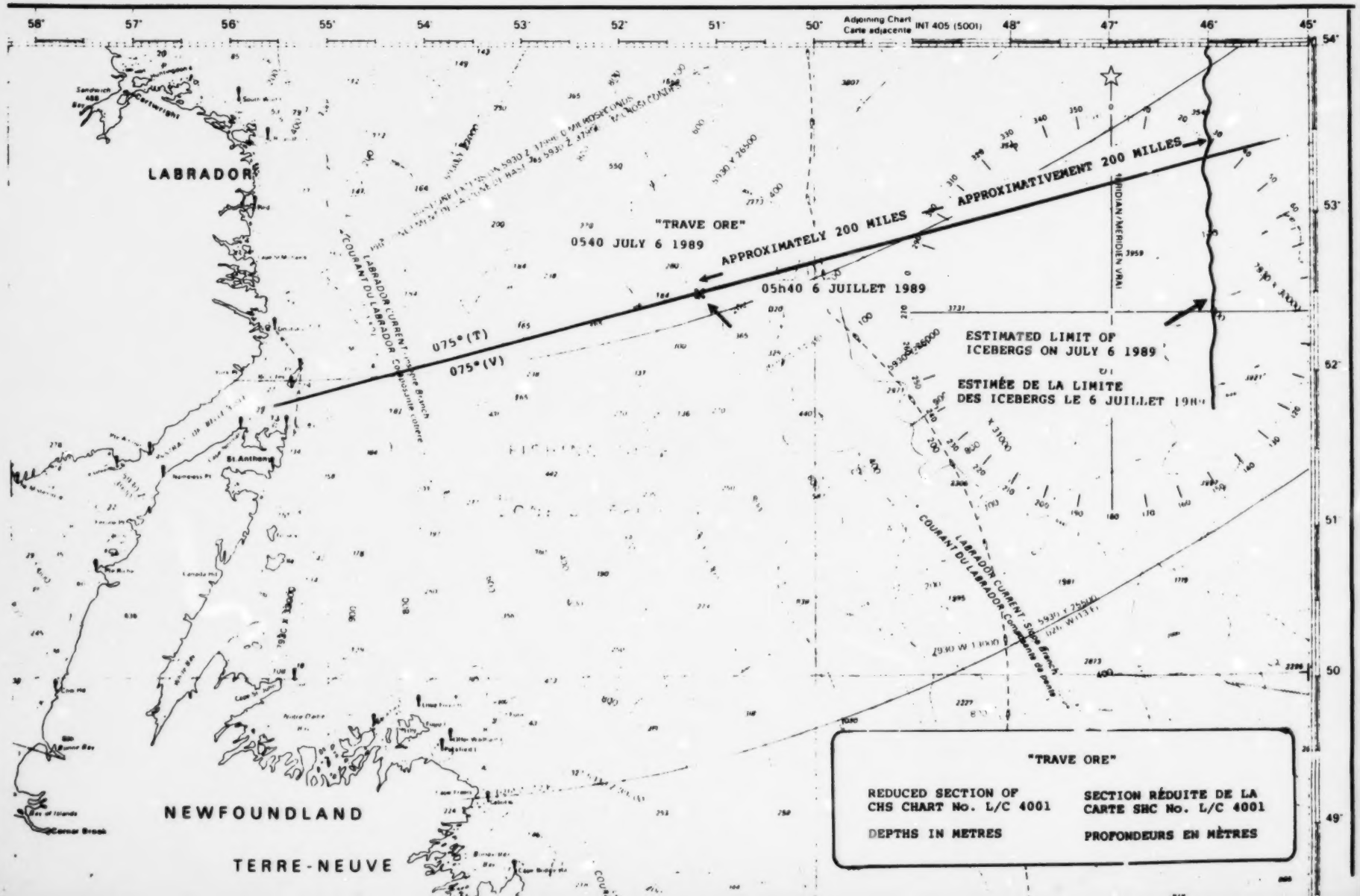
The master, or another officer, was not on the bridge to assist in the navigation under the adverse conditions which prevailed.

The master and the other officers were not familiar with the vessel's time and stopping distance.

The vessel was not stopped immediately after the casualty, but continued at full service speed for some 50 minutes, and then for a further 1 hour 18 minutes before the engine was stopped.

MARINE CASUALTY INVESTIGATIONS
TRANSPORT CANADA
110 O'CONNOR STREET
OTTAWA, ONTARIO
K1A 0N5

DECEMBER, 1989.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CARTE SHC No. L/C 4001
PROFONDEURS EN MÈTRES

ANNEX I

Description of Ice

Three categories of ice are considered to be relevant to this inquiry.

The following description is extracted from the manual of Ice Reporting, published by Environment Canada.

1. Iceberg: A massive piece of ice of greatly varying shape, more than 5 m above sea-level, which has broken away from a glacier, and which may be afloat or aground. Icebergs may be described as tabular, dome shaped, sloping, pinnacled, weathered or glacier bergs.

2. Bergy bit: A large piece of floating glacier ice generally showing less than 5 m above sea-level but more than 1 m and normally about 100-300 sq.m. in area.

3. Growler: Smaller piece of ice than a bergy bit or floe berg, often transparent but appearing green or almost black in colour, extending less than 1 m above the sea-surface ance normally occupying an area of about 20 sq.m.

APPENDICE I

Description des glaces.

Trois catégories de glaces sont pertinentes à cette enquête.

Les définitions suivantes sont extraites du manuel des méthodes de reconnaissance des glaces publié par Environnement Canada.

1. Iceberg: Importante masse détachée d'un glacier, de forme très variable, s'élevant à plus de 5 m au-dessus du niveau de la mer, et qui peut être flottante ou échouée. Les icebergs peuvent être tabulataires, en dôme, en pente, pointus, érodés ou des icebergs de glacier.

2. Fragment d'iceberg: Vaste bloc flottant de glace de glacier qui émerge généralement de 1 à 5 m et qui à habituellement une superficie de 100 à 300 mètres carrés.

3. Bourguignon: Bloc de glace plus petit qu'un fragment d'iceberg ou qu'un floeberg; souvent transparent, mais paraissant vert ou presque noir, il émerge de moins de 1 m et s'étend habituellement sur une superficie de 20 mètres carrés environ.

Ice Reports.

Subsequent to the sinking of the TITANIC in 1912, an International Ice Patrol was set up. This is a service administered by the United States Coast Guard and information is available to all shipping interests.

It guards the south-eastern southern and south-western limits of the regions of icebergs in the vicinity of the Grand Banks of Newfoundland. Ice Patrol brodcasts a bulletin twice each day and a daily radio-facsimile chart containing ice information to inform ships of the extent of this dangerous region.

This bulletin is received and retransmitted by Canadian Coast Guard Radio Stations and is available at any time upon request. These bulletins usually request vessels in the vicinity to provide their position, ice conditions, sea surface temperature and weather conditions and contain the warning "all mariners are urged to use exreme caution when transiting near the Grand Banks, since other ice may be in the area".

Bulletins des glaces.

Suite au sinistre du navire "TITANIC" en 1912, un Service international de patrouille des glaces a été mis sur pied. Ce service est administré par la Garde côtière des Etats-Unis. Les renseignements sont disponibles aux interessés dans le domaine maritime.

Le service veille sur les limites sud-est, sud et sud-ouest de la zone des icebergs aux Grand Bancs de Terre-Neuve. Des informations portant sur l'étendue des glaces dans cette zone dangereuse sont radiodiffusées par le Service dans un bulletin transmis deux fois par jour et par une carte radio-facsimilé quotidiennement.

Ce bulletin est capté et retransmis par les stations radio de la Garde côtière canadienne et il est disponible à toute heure sur demande. Le bulletin requiert normallement que les navires fournissent des informaitons sur leurs positions, les conditions des glaces, la température de la mer en surface, les conditions météorologiques ainsi qu'un bulletin d'avertissement:
"On demande aux navigateurs d'être très vigilant dans les parages des Grand Bancs à cause de la présence de glaces dans le secteur.

(Traduction libre).

ANNEX II

The use of radar and its limitations in ice infested waters.

Icebergs are often not detected at ranges as long as might be expected. Cases have been reported of bergs looming so large to the eye that it would seem almost impossible for these to escape detection by radar, and yet producing no echo until they are even closer. Antarctic bergs have sides which are noticeably sheer compared with Arctic bergs.

The strength of reflection of radar waves from ice on the Grand Banks is 60 times less than from a ship of equivalent echoing area. Perhaps the detection of ice is most uncertain when it is encountered in the form of growlers which are seldom detected at more than 4 miles and return echoes which are almost impossible to distinguish amidst strong sea clutter. Waves of 4 ft high might obscure a dangerous growler despite expert use of sea clutter control and differentiators.

As a warning of such ice in the vicinity of a ship, a radar set is unreliable, and as the bulk below water of some growlers is quite sufficient to damage a ship, every precaution is necessary when navigating in ice conditions.

APPENDICE II

Utilisation du radar et ses limites dans les eaux où il y a beaucoup de glaces.

Souvent, les icebergs ne sont pas détectés à des portées aussi grandes auxquelles on s'attend. On rapporte, dans certains cas, que les icebergs sont si énormes à l'oeil qu'il leur semble impossible d'échapper à la détection au radar mais qui ne produisent pas d'écho avant qu'ils ne soient encore plus près. Les icebergs de l'Antarctique ont les côtés visiblement abrupts comparativement à ceux de l'Arctique.

La puissance des ondes radar réfléchies par les glaces sur les Grands Bancs sont 60 fois plus petites que celles d'un navire au secteur réfléchi équivalant. Peut-être que la détection de glace est la moins certaine quand elle apparaît sous forme de bourgignons qui sont rarement détectés à plus de 4 milles et que les échos réfléchis sont presque impossibles à distinguer parmi un fort clapotis de mer. Les vagues d'une hauteur de 4 pieds peuvent cacher un bourgignon dangereux malgré l'utilisation du contrôle de clapotis de mer et de ces différenciateurs, même de façon compétente.

On ne peut compter sur un appareil radar pour avertir de la présence de ce genre de glaces dans les environs d'un navire. Comme la partie submergée de certains bourgignons est suffisante pour endommager un navire, il faut prendre toutes les précautions nécessaires lors de la navigation dans les glaces.

(Traduction libre)

ANNEX III

M.V. "TRAVE ORE"

Surveyed at anchor at Bay of Islands, Corner Brook, Newfoundland, on July 12th and 13th, 1989, to ascertain the nature and extent of damage alleged to have been sustained as a result of striking an iceberg, on June 6th, 1989, at the position 52°26'N and 51°13'W, while on a loaded passage from Port Cartier, P.Q., to Hamburg, West Germany.

Frames numbered from aft
Approximate drafts F 17 m, A 13.4 m
All sizes are approximate
Shell plates numbered from forward

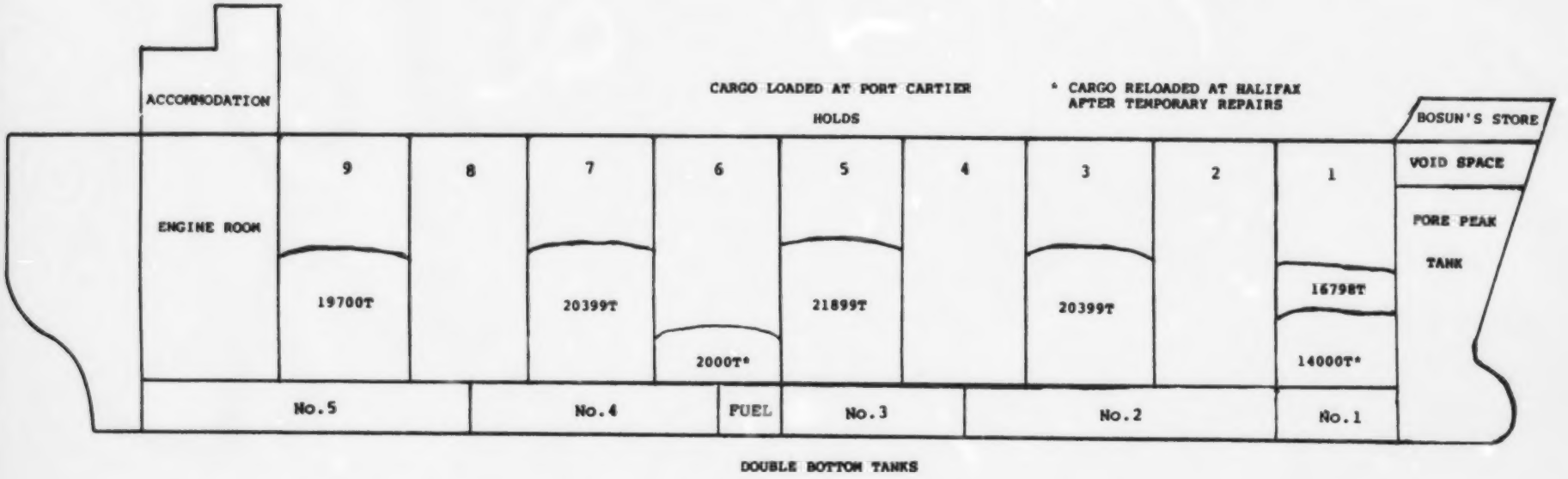
Found	Recommended
All damages appear to be confined to the bow structure back to a location just aft of the forepeak bulkhead.	
(1) Bow structure below 17 m waterline and including bulbous configuration, according to divers' reports and videos shown, badly holed, twisted, torn and peeled back under keel line. Damages appear to go back to forepeak bulkhead and just beyond.	Bow structure below 17 m waterline and back to the proximity of the forepeak bulkhead to be renewed. It would appear at this time that all the internal structure will require to be renewed.
(2) Soft nose stem set down and back	Rolled stem to be further examined to determine extent of further renewals. Plate thickness varies from .71" to 1.05" at lower end.
Starboard Bow	
(3) Strake P4 shell plates Nos. 1 & 2 forward area set down and after area creased full height.	To be renewed. Size 40' x 8' x .50"
(4) Strake P3 shell plate No. 1 set down at forward area and after end creased full height.	To be renewed. Size 40' x 8' x .50"

(5) Strake P2 shell plate No. 1 creased full height at at midbody.	To be renewed. Size 30' x 6' x 50"
(6) Strake P1 shell plate No. 1 set in and buckled full length.	To be renewed. Size 45' x 5' x .50"
(7) Strake 0 shell plate No. 1 set in and buckled full length.	To be renewed. Size 50' x 5' x .50"
(8) Internal structure, shell frames, web frames, stringers, brackets variously buckled and distorted.	To be further examined to determine extent of necessary repairs.
Port Bow	
(9) Strake P4 shell plates Nos. 1 & 2 creased full height in two locations and set down at forward area.	To be cropped and renewed. Size 50' x 8' x .50"
(10) Strake P3 shell plates Nos 1 & 2 creased full height in three locations and set down at forward area.	To be cropped and renewed Size 50' x 8' x .50"
(11) Strake P2 shell plates Nos. 1 & 2 set in and wrinkled full height.	To be cropped and renewed. Size 45' x 6' x .50"
(12) Strake P1 shell plate No. 1 set in and wrinkled full height.	To be cropped and renewed. Size 45' x 5' x .50"
(13) Strake 0 shell plate No. 1 set in bodily all over.	To be cropped and renewed. Size 45' x 5' x .50"
(14) Internal structure, shell frames, web frames, stringers, brackets, variously buckled and distorted.	To be further examined to determine extent of necessary repairs.
Foc'sle Deck	
(15) Foc'sle deck set down bodily from hawse pipes forward.	Deck to be cropped and part renewed. Dimensions of this semi-circular area are approximately 80' wide x 30' deep.

	Removals for access would include: Bulwark with guard rail and mast. 4 fairleads 3 air vents 1 hatch 4 double mooring bitts All to be replaced in good order. Deck beams to be further examined to determine extent of necessary repairs.
Main Deck - Bosun's Store	
(16) Deck of bosun's store wrinkled and undulating all over with deep athwartship crease in way of hatch coaming. Hatch coaming distorted.	Deck to be cropped and renewed. Dimensions approx. 120' wide x 65' deep. Hatch coaming to be renewed. Approx. 40" x 40" x 9" high. Deck beams and girders to be further examined to determine extent of necessary repairs. Removals for access could include: 2 diesel driven air compressors. Various deck stores.
Forepeak Tanktop - Void Space	
(17) Tanktop badly wrinkled, torn in places, all along port side and around forward end.	To be cropped and part renewed. Approx. total area involved 120 sq.ft. Support beams to be surveyed when vessel drydocks and tank empty.
Miscellaneous	
(180 Port hawse pipe fractured in two locations and collar parted from shell.	To be further examined to determine if repairable.
(19) Port anchor stock appears to be bent.	To be further examined.

(20) Forepeak bulkhead suspect.	To be further examined on drydock to determine extent of necessary repairs.
(21) Shell plating in way of No. 1 port D.B. tank indented and holed.	To be further examined on drydock and dealt with as necessary.
(22) Main engine holding down bolts and chocks.	To be checked and crank-shaft deflections to be recorded.
(23) All cargo hatch covers.	To be tested for possible impact damage.

"TRAVE ORE"



ANNEX IV

ANNEX V

REGULATIONS FOR THE PREVENTION OF COLLISIONS

Short Title

1. These Regulations may be cited as the *Collision Regulations*.

PART A—GENERAL

RULE 2

Responsibility

(*a*) Nothing in these Rules shall exonerate any vessel, or the owner, master or crew thereof, from the consequences of any neglect to comply with these Rules or of the neglect of any precaution which may be required by the ordinary practice of seamen, or by the special circumstances of the case.

(*b*) In construing and complying with these Rules due regard shall be had to all dangers of navigation and collision and to any special circumstances, including the limitations of the vessels involved, which may make a departure from these Rules necessary to avoid immediate danger.

PART B—STEERING AND SAILING RULES

SECTION I—CONDUCT OF VESSELS IN ANY CONDITION OF VISIBILITY

RULE 4

Application

Rules in this Section apply in any condition of visibility.

RULE 5

Look-out

Every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision.

RULE 6

Safe Speed—International

Every vessel shall at all times proceed at a safe speed so that she can take proper and effective action to avoid collision and be stopped within a distance appropriate to the prevailing circumstances and conditions.

In determining a safe speed the following factors shall be among those taken into account:

(*a*) By all vessels:

(i) the state of visibility,

(ii) the traffic density including concentrations of fishing vessels or any other vessels,

APPENDICE V

RÈGLEMENT POUR PRÉVENIR LES ABORDAGES

Titre abrégé

1. Le présent règlement peut être cité sous le titre: *Règlement sur les abordages*.

PARTIE A—GÉNÉRALITÉS

RÈGLE 2

Responsabilité

a) Aucune disposition des présentes règles ne saurait exonérer soit un navire, soit son propriétaire, son capitaine ou son équipage des conséquences d'une négligence quelconque quant à l'application des présentes règles ou quant à toute précaution que commandent l'expérience ordinaire du marin ou les circonstances particulières dans lesquelles se trouve le navire.

b) En interprétant et en appliquant les présentes règles, on doit tenir dûment compte de tous les dangers de la navigation et des risques d'abordage, ainsi que de toutes les circonstances particulières, notamment les limites d'utilisation des navires en cause, qui peuvent obliger à s'écarter des présentes règles pour éviter un danger immédiat.

PARTIE B—RÈGLES DE BARRE ET DE ROUTE

SECTION I—CONDUITE DES NAVIRES DANS TOUTES LES CONDITIONS DE VISIBILITÉ

RÈGLE 4

Champ d'application

Les règles de la présente section s'appliquent dans toutes les conditions de visibilité.

RÈGLE 5

Veille

Tout navire doit en permanence assurer une veille visuelle et auditive appropriée, en utilisant également tous les moyens disponibles qui sont adaptés aux circonstances et conditions existantes, de manière à permettre une pleine appréciation de la situation et du risque d'abordage.

RÈGLE 6

Vitesse de sécurité—International

Tout navire doit maintenir en permanence une vitesse de sécurité telle qu'il puisse prendre des mesures appropriées et efficaces pour éviter un abordage et pour s'arrêter sur une distance adaptée aux circonstances et conditions existantes.

Les facteurs suivants doivent notamment être pris en considération pour déterminer la vitesse de sécurité:

a) Par tous les navires:

(i) la visibilité;

(ii) la densité du trafic et notamment les concentrations de navires de pêche ou de tous autres navires;

(ii) the traffic density including concentrations of fishing vessels or any other vessels,

(iii) the manœuvrability of the vessel with special reference to stopping distance and turning ability in the prevailing conditions,

(iv) at night the presence of background light such as from shore lights or from back scatter of her own lights,

(v) the state of wind, sea and current, and the proximity of navigational hazards,

(vi) the draught in relation to the available depth of water.

(*b*) Additionally, by vessels with operational radar:

(i) the characteristics, efficiency and limitations of the radar equipment,

(ii) any constraints imposed by the radar range scale in use,

(iii) the effect on radar detection of the sea state, weather and other sources of interference,

(iv) the possibility that small vessels, ice and other floating objects may not be detected by radar at an adequate range,

(v) the number, location and movement of vessels detected by radar,

(vi) the more exact assessment of the visibility that may be possible when radar is used to determine the range of vessels or other objects in the vicinity.

(ii) la densité du trafic et notamment les concentrations de navires de pêche ou de tous autres navires;

(iii) la capacité de manœuvre du navire et plus particulièrement sa distance d'arrêt et ses qualités de giration dans les conditions existantes;

(iv) de nuit, la présence d'un arrière-plan lumineux tel que celui créé par des feux côtiers ou une diffusion de la lumière des propres feux du navire;

(v) l'état du vent, de la mer et des courants et la proximité de risques pour la navigation;

(vi) le tirant d'eau en fonction de la profondeur d'eau disponible.

b) De plus, par les navires qui utilisent un radar:

(i) les caractéristiques, l'efficacité et les limites d'utilisation de l'équipement radar;

(ii) les limitations qui résultent de l'échelle de portée utilisée sur le radar;

(iii) l'effet de l'état de la mer, des conditions météorologiques et d'autres sources de brouillage sur la détection au radar;

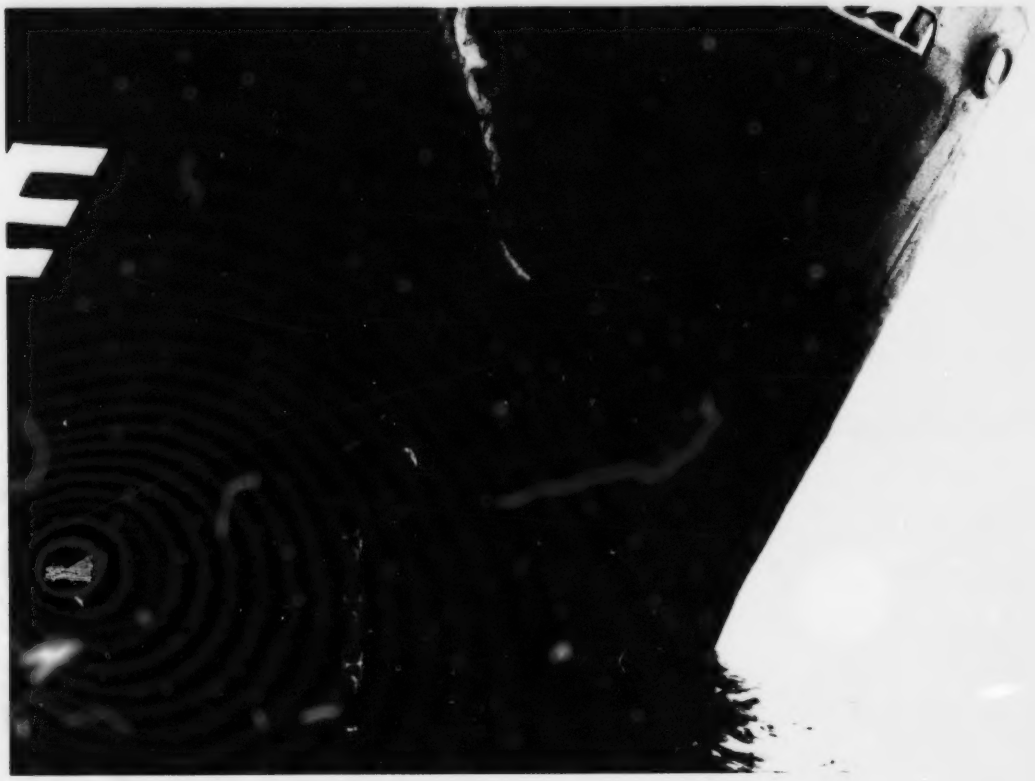
(iv) le fait que les petits bâtiments, les glaces et d'autres objets flottants peuvent ne pas être décelés par le radar à une distance suffisante;

(v) le nombre, la position et le mouvement des navires détectés par le radar;

(vi) le fait qu'il est possible d'apprécier plus exactement la visibilité lorsque le radar est utilisé pour déterminer la distance des navires et des autres objets situés dans les parages.

"TRAVE ORE"
À Halifax, le 21 juillet 1989.

"TRAVE ORE"
At Halifax, July 21, 1989.



Starboard bow

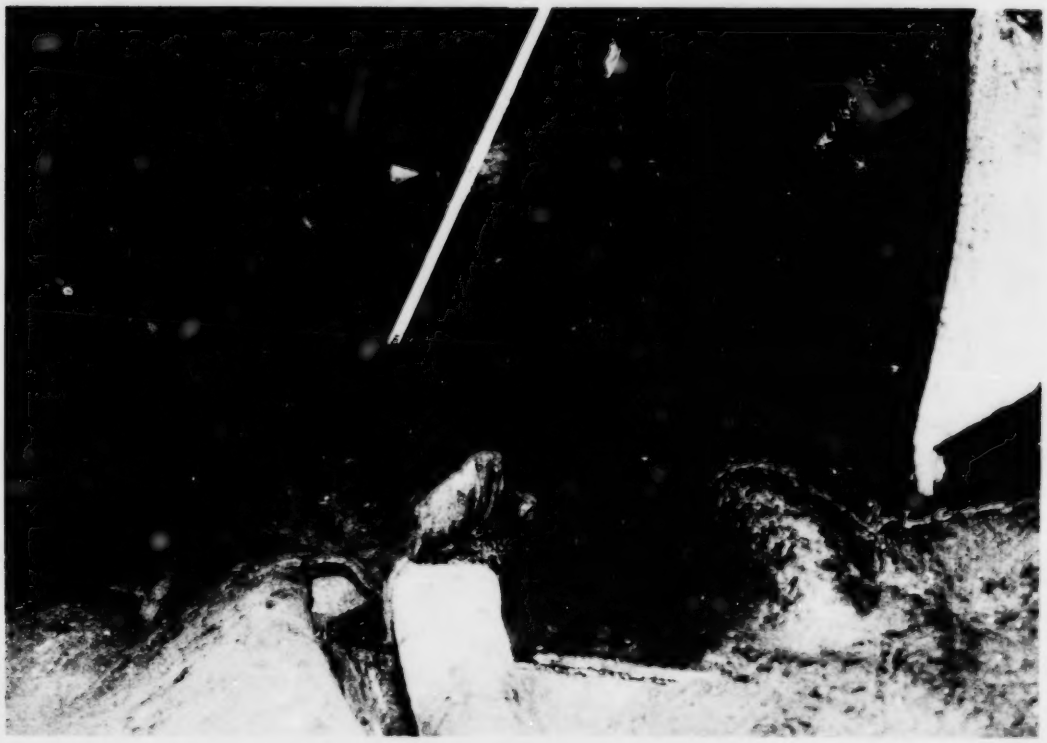
Étrave tribord

Port bow

Étrave bâbord

Compartiment mort - plafond de baliast du peak avant.

Void space fore peak tank top.



Main deck (Bosun's store)

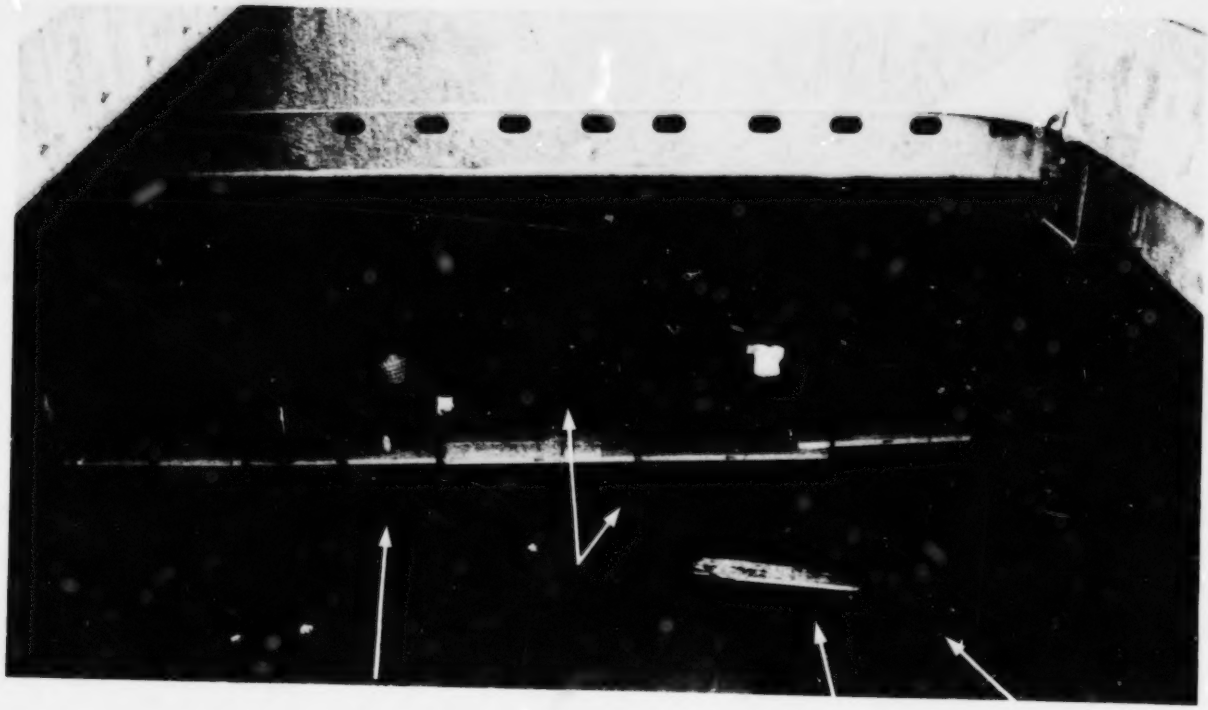
Pont principal (magasin du maître d'équipage)

Access down to void space.

Accès au compartiment mort en-dessous.

Main deck (Bosun's store), looking aft to port side.

Pont principal (magasin du maître d'équipage), vue vers bâbord arrière.



N°1 cargo hold	Collision bulkhead	Channel bar stiffening	Iron ore concentrate	Submersible pump
Cale N°1	Cloison d'abordage	Renfort par fers en U	Concentré du minerai de fer	Pompe submersible

Main deck from void space under.

Pont principal, vue du compartiment mort en-dessous.

Main deck,
under,
as viewed
from void
space looking
forward.

Pont principal,
en-dessous,
vu du
compartiment
mort vers
l'avant.

"TRAVE ORE" à Québec après
le déchargement de cargaison.

"TRAVE ORE" at Quebec City
after cargo had been
discharged.